Impact of porous texture of carbon derived from polymer precursors and coalesced carbon onion anode on performance of electrochemical capacitors

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Supercapacitors are receiving extensively attention as potential energy storage devices due to their high capacitance, high power density, and long cycle life. Carbon materials play an important role in energy storage and conversion, due to their structural diversity, natural abundance, high electrical conductivity, high thermal and chemical stability, tunable physical and chemical properties, and economic viability. In addition, pore size distribution, microstructure, particle size of carbon based electrodes have tremendous effect in achieving high energy and power in supercapacitors.

In this investigation, several carbon-based electrodes were synthesized using polymer precursor in the presence of surfactant (soft templating method). Effect of pore size and polymer precursor was investigated in both symmetric and asymmetric electrochemical capacitors. Fabricated symmetric capacitor exhibited a specific capacitance of 136 F/g at 1 A/g when charged and discharged between 0 to 3.8V using neat 1-butyl 3-methylimidazolium tetrafluoroborate electrolyte. Furthermore, rate capability of Lithium ion capacitor was studied using polymer derived carbon in conjunction with coalesced carbon onion based anode. The fabricated capacitor exhibited time constant in the order of 1.45s. Moreover, use of interconnected carbon onion accelerated electron and ion transport led to minimal resistance. The maximum achievable energy density was 120 Wh/kg with the capacitor retaining 77 Wh/kg even at a high power density of 11 KW/kg. The fabricated device was able to be charge and discharged from 2.2 V to 4V with 90% energy efficiency with 80% capacitance retention over 21000 cycles.